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Beyond virtual museums: Experiencing immersive virtual reality in real museums

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A R T I C L E I N F O

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A B S T R A C T

Contemporary museums are much more than places devoted to the placement and the exhibition of collections and artworks; indeed, they are nowadays considered as a privileged means for communication and play a central role in making culture accessible to the mass audience. One of the keys to approach the general public is the use of new technologies and novel interaction paradigms. These means, which bring with them an undeniable appeal, allow curators to modulate the cultural proposal by structuring different courses for different user profiles. Immersive Virtual reality (VR) is probably one of the most appealing and potentially effective technologies to serve this purpose; nevertheless, it is still quite uncommon to find immersive installations in museums. Starting from our 10 years' experience in this topic, and following an in-depth survey about these technologies and their use in cultural contexts, we propose a classification of VR installations, specifically oriented to cultural heritage applications, based on their features in terms of interaction and immersion. On the basis of this classification, aiming to provide a tool for framing VR systems which would hopefully suggest indications related to costs, usability and quality of the sensorial experience, we analyze a series of live examples of which we point out strengths and weak points. We then summarize the current state and the very next future, identifying the major issues that prevent these technologies from being actually widespread, and outline proposals for a more pervasive and effective use of Immersive VR for cultural purposes.

1. Research aims

Following an analysis related to the use of Virtual reality (VR) technologies in cultural context, we propose a novel categorization for VR systems and installations operating in the above mentioned contexts, which classifies them on the interaction and immersion axes. This categorization might help, when designing systems of this kind, in providing useful side information, like the value of the perceived sensorial experience and the "quick" usability of these systems, the first being important as a measure of the provided feeling of presence (typically one of the most important targets in a virtual experience), the second because in exhibition contexts it is important to immediately engage users, allowing them to interact with fast learning curves and in the most natural way.

Based on these elements, we provide an in-depth discussion, identifying some of the most relevant issues related to using these technologies in public contexts and suggesting a number of proposals, grounded on the observation of recent trends, to improve the experience provided by this kind of systems and contribute to a more widespread diffusion of such compelling cultural supports.

2. Introduction

The museum is a relatively recent institution and only in the second half of the xx century the basic principles of contemporary museums were stated: museums should be able to elastically "bend" and become a privileged tool for communication [1], assisting the cultural experience and, whenever opportune, making use of technologies and wide spectrum systems. When talking about "new technologies", we conventionally mean mainly visual technologies, which put the image at the center of the communication, and interactive technologies, demanding users to act and choose; these means radically change the learning process [2]: the user observes and perceives the object by means of his/her senses and controls the object or the action through his/her movements, a more natural and instinctive way of learning than the one based on symbols, which are inaccessible to perception.

If this, on one side, has helped in making culture accessible to the mass audience, on the other side, it has started a process of desacralization of the museum institution, which would extend its boundaries across the modern entertainment industry. This

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resulted in a potentially dangerous mixture that has contributed in creating a certain mistrust about technological innovations which ICT brings inside the laical temple par excellence.

Therefore, museums must be able to diversify their structures and proposals: if average users are offered an educational/divulgation path, professional users will be proposed a more scientific and systematic tool. Real users, potential users, and remote internet users are new categories of public which museums must address by exploiting new technologies so as to communicate and promote at best its heritage. This happens more frequently, and probably with more efficacy, in science museums where, because of their own nature, the concept of structure-container is more easily forsaken to become an increasingly lively reality, where the attention is focused on compensating the strains of the visit with playful-educational activities. Nevertheless, interactive technologies, and notably VR, have nowadays gained consent at an international level also in traditional museums and in cultural expositions or events. Despite of this general consent, it is still very uncommon to bump into immersive installations when visiting museums. In this paper, we will try to analyze this phenomenon, describe some existing examples, propose a categorization of VR installations, individuate their strengths and weaknesses, discuss the current state and the very next future, and outline proposals for a more pervasive and effective diffusion of this technology for cultural purposes.

3. Materials

3.1. Virtual environments

Although the term VR might be considered almost universally known, to correctly define it is not an easy task. Googling on “VR” will likely produce several possible definitions apparently equivalent, yet presenting non negligible distinctions: a “human-computer interface”, a “computer generated environment”, a “3D computer simulation”, “a technology” and many others. This is not surprising, as VR is actually all of this. Mediating among these assertions, VR can be properly defined as a complex technology which exploits more low-level technologies (such as computer science, 3D graphics, robotics etc.) in order to create a digital environment which users feel completely immersed inside, and which they may interact with.

This technology-oriented definition of VR may help in making clearer to the public its basics and its applications, even if it might weaken the appeal that the “romantic” facet of VR (commonly considered as an alternative reality) still exerts on the mass, at the same time risking to keep it in a perpetual state of science-fiction topic. The same oxymora VR – reportedly coined [3] by one of its pioneers – has probably contributed since the beginning to generate exceeding expectations. Hence, nowadays the less charming, yet more precise, denomination of Virtual Environments (VE) is becoming increasingly popular.

Although not (yet) a mass phenomenon, VR is nowadays a mature technology, increasingly used in specific sectors because of its unique features in terms of immersion and interaction. Immersion can be defined as the physical feeling of being in a virtual space. Usually it is achieved by means of sensory interfaces which “surround” the user. Interaction is related to the user capability of modifying the environment and receiving a feedback to his/her actions.

Both immersion and interaction concur to realize what is one of the main goals of a virtual experience: presence, i.e. the belief of actually being in a virtual space.

There are several possible embodiments for a VR system, each characterized by the type of devices, the user workspace and the provided levels of immersion, interaction and presence. In Immersive VR, all the three components are substantially present. Some of the commonly available features are: dynamic visual perspective based on user’s head movements, stereoscopic vision, binaural acoustical feedback, realistic interaction with the environment by means of interfaces for the manipulation, operation and control, haptic and (less often) motion feedback. Desktop VR can be considered as a subset of Immersive VR, where limited installations are realized using desktop components (e.g. monitors, mouse/joystick/keyboard, etc.). Although limited, this kind of systems represents, for many people, the only cost-effective and therefore realistically possible access to VR applications.

3.2. Virtual environments and Museums

Although the use of VR is widespread in some specific sectors – like industry, medicine, training, etc. – in latest years, VR technologies have been rapidly gaining consent and positive reception also in the field of Cultural Heritage, for a number of different applications. In the field of conservation and restoration, VR constitutes a means to reconstruct artworks or artistic/historical environments that time may have destroyed or damaged, so as to preserve and safeguard them [4], or it can be used as an assistance tool for restoration actions [5], and even to perform virtual restoration on damaged areas of artworks without affecting the original specimens. Moreover, being an extremely attractive technology, VR is nowadays more and more used [6,7] as education, divulgation or storytelling tool, as information is not mediated by linguistic codes but conveyed mostly by sensorial feedback (images, sounds, etc.) and therefore easily understood even by non-specialized users.

Based upon what has so far been exposed, it may seem that the relationship between VR and Cultural Heritage is more than consolidated and that cultural institutions, primarily museums, would be able to adequately exploit the potential of this appealing technology. This certainly happens in science museums, like the London Science Museum[2] or the San Francisco Exploratorium[3]. These museums are usually strongly bent on edutainment and on being hands-on: almost all hosted installations are interactively accessible by users. Traditional museums are less inclined to open out to VR technologies, with a partial exception for contemporary art museums. However, in this case, VR is often used as a means to produce new forms of art, rather than to communicate existing artworks. When dealing with “classical” instances, an important role is commonly played by multimedia [8] or, more recently, multimodal [9] kiosks. However, due to their limited dimensions, they usually lack immersive features. Significant immersive cultural experiences need dedicated hardware appliances, like the CINECA Virtual Theatre[4] or the ReaCTor at the Foundation of Hellenic World[5], and consequently dedicated exhibit spaces.

A valid attempt to present a unified approach to manage virtual exhibitions, from the authoring to the presentation stages, is the ARCO framework [10], realized in the context of the UE FP5 research program. In addition to web capabilities, the ARCO platform addressed also Augmented Reality visualizations, covering a wide spectrum of possible alternative representations of digital content. Particularly interesting are interfaces exploiting multiple modes (for instance mixing visual, acoustical and haptic feedback) in order to realize digital heritage exhibitions [11].

If considering virtual exhibitions in their widest meaning, a particular attention should be devoted to virtual museums on the web,

[2] http://www.sciencemuseum.org.uk/.
[3] http://www.exploratorium.edu/.
[4] http://www.cineca.it/visit/virtualtheatre.html.
[5] http://www.fhw.gr/vr/en/docs/in_exhibits.html.

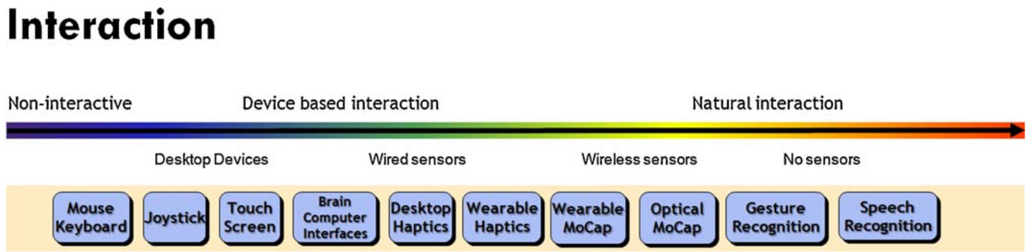

Fig. 1. Classification of VR devices on the interaction axis.

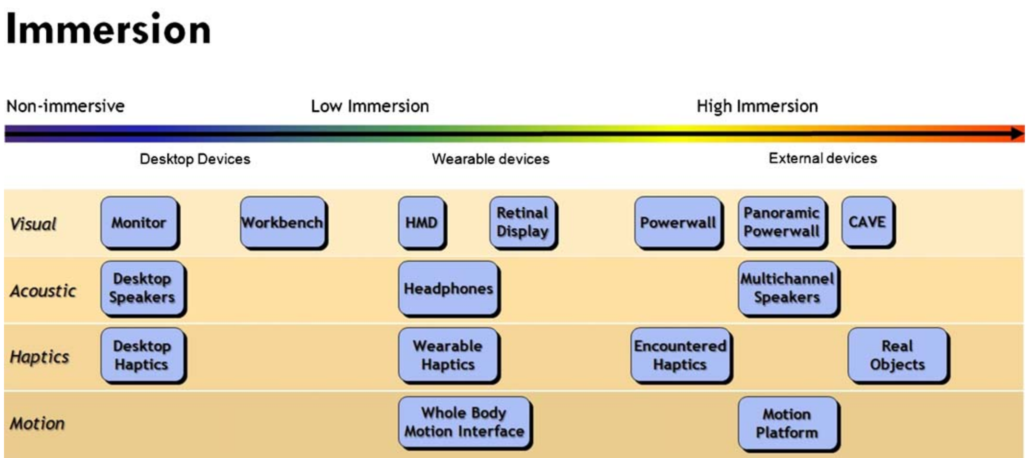

Fig. 2. Classification of VR devices on the immersion axis.

especially the latest generation ones making an intensive use of 3D graphics.

A wide range of examples are available on Internet, often realized with deeply etherogeneous aims, approaches and technologies. Some of them share technological components with more advanced platforms; a thorough survey of these applications is presented in [12] together with a selection of methods and tools not limited to web-VR but extending also to Mixed Reality solutions.

Albeit web-based virtual museums represent an attractive complement to real museums activities, in this context they should be considered not more than good examples of Desktop VR. What we want to focus on, instead, are the opportunities and the consequent issues related to the use of Immersive VR in museum contexts [13]. For this purpose, it may result functional to discuss the different possible embodiments of these systems in terms of devices, aims and living examples coming from our experience, so as to derive elements useful as an input for a subsequent analysis.

4. Methodologies

4.1. A classification for VR installations

VR systems may be categorized in many ways, depending on the factors we want to stress. A possible classification can be based on the level of abstraction of the VEs, starting from totally abstract VEs (such as Information landscapes), to non-realistic VEs (where abstract and realistic elements are copresent), to realistic VEs (either modeled or digitally acquired), to photo-realistic VEs, which may be hardly distinguishable from real counterparts. Other possible factors are multimodality (how many sensorial channels are stimulated, and which ones?) or the quality of rendering information. In this paper, we propose a categorization based on the level of immersion and interaction provided by VR systems, in particular keeping into account the characteristics of the interface devices.

On the interaction axis, systems may be classified in three main categories: “non-interactive”, “using mediated interaction”, “using natural interaction”. On this axis, we place systems in increasing order of “naturalness” starting from systems using devices demanding a high level of mediation of the interaction metaphor (like keyboards, joysticks, etc.) up to devices which recognize natural human behaviors (like motion capture devices, speech recognition systems, etc.) and therefore, have a more direct correspondence with users actions.

On the orthogonal axis, we classify systems depending on the provided level of immersion, starting from non-immersive ones (i.e. desktop systems), to more immersive systems arranged on a decreasing level of invasiveness (wearable devices are considered more invasive than non wearable ones).

Following this proposal, VR systems are therefore categorized on the x-y plane on increasing levels of non-invasive immersion and natural interaction. In principle, the top-right area should represent the “best” region, where are placed systems which should supposedly generate a high level of presence. As mentioned in 2.1, there are also other factors to keep into account, mostly subjective, like the user tendency to the “suspension of disbelief”. Nonetheless, systems with such levels of immersion and interaction are excellent candidates to provide a significant virtual experience (Figs. 1 and 2).

4.2. Our experience

Following a 10-year experience in the realization and integration of VR technologies and systems, PERCRO (an engineering laboratory of Scuola Superiore Sant’Anna, Pisa, Italy) has been developing a consistent number of VR applications aimed at promoting cultural content, either distributed on the web or hosted in

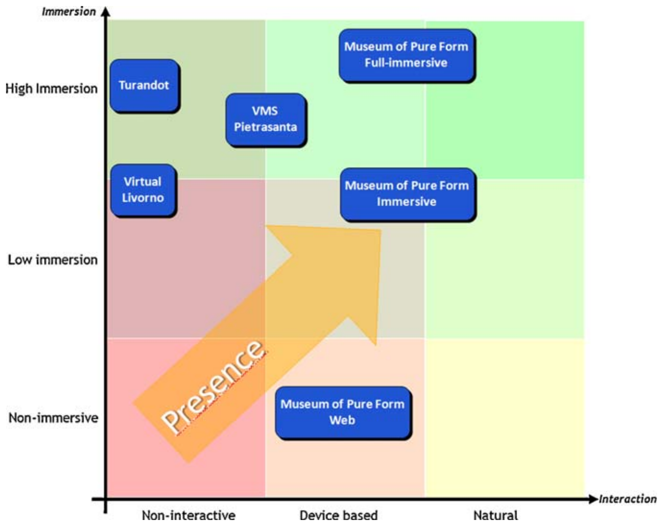

Fig. 3. The presented VR systems in the proposed classification.

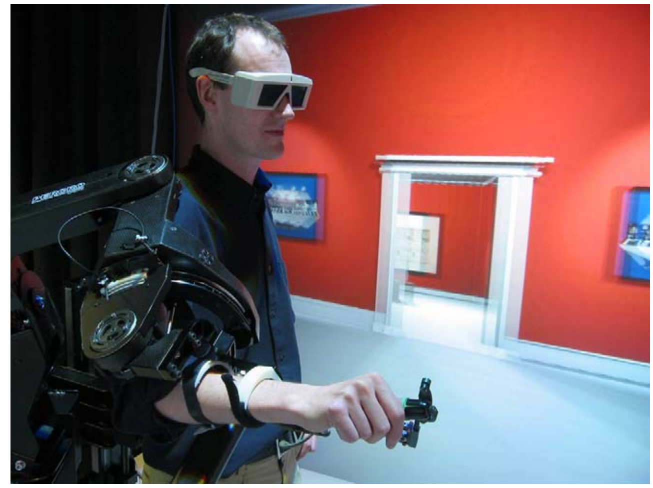

Fig. 4. Museum of Pure Form, full immersive installation.

permanent installations exposed in museums or in other cultural institutions. In subsequent sections, a set of living examples, framed (see Fig. 3) accordingly to the classification above proposed, will be presented together with a brief discussion about their strengths and weaknesses and, whenever available, the results of user evaluations.

4.2.1. The Museum of Pure Form

The Museum of Pure Form (MPF) [14] aims at exploring new paradigms of interaction with sculptural pieces of art. In traditional museums, visitors may commonly only observe the exposed statues because, for security reasons, they are not allowed to touch them; moreover, any fruition of these artistic works is denied to blind and visually impaired users. Through VR, the MPF offers art a way beyond such limits by giving the haptic perception of artistic forms the same essential role, it had for the artist when creating them. The use of haptic interfaces allows users to perceive suitable tactile stimuli to be able to simulate the hand while in contact with the digital copy of a real statue. In addition, the realism of the virtual simulation is increased when integrated with the stereoscopic visualization of digital models, giving users the real feeling of touching the surface being visualized in the space beneath their own hands.

Several museums were involved in the project. The Galician Centre for Contemporary Arts of Santiago de Compostela (Spain), the Museo dell'Opera del Duomo in Pisa (Italy), and the National Museum of Fine Arts of Stockholm (Sweden) actively participated to the project by hosting and organizing public temporary exhibitions.

The MPF concept was exhibited in two ways. Temporary physical installations were presented to the public at the sites of participating museums. One of these installations has become permanent, hosted at the OPAE premises. Two different setups have been realized, one "full-immersive" (Fig. 4) featuring a CAVE system and an exoskeleton, and another "immersive" featuring a stereo powerwall with a large desktop haptic device.

Afterwards, a Web setup using VR technologies has been realized [15] where all of the digitized sculptures are accessible in a single, unified virtual exhibition. A distinct feature of the Pure Form Web site is that haptic interaction, initially possible only at the physical museums installations, has subsequently been added to the Web exposition as well. In this case, a commercial desktop haptic interface, the Sensable Phantom, is used to experience force feedback.

Experimental results [16,17] showed that visiting the MPF has proven to be a pleasant experience enhanced by the use of the haptic device. Most of the visitors (70%) in general found the experience of the haptic display amusing. Mean high judgments were also obtained for questions about the instructiveness of the experience, and the positive judgments are in majority concerning the questions about "suggesting friends to visit" and "wanting similar devices in other museums". On the other side, the suggested improvements indicate that many visitors wanted to be able to more fully utilize the capabilities of the haptic sense, especially to use larger parts of their hands. Many users complained about the long time needed to adapt to virtual haptic feedback. As a consequence, a training session which enables exploring simpler shapes has been added to the experience. An important issue to consider is that the setup makes use of complex devices that need trained people to be operated. This is one of the reasons why the permanent installation is actually intermittently open, as the costs of personnel to keep the system operative are significant.

4.2.2. The Virtual Museum of Sculpture

Developed as an extension of the MPF concept, the Virtual Museum of Sculpture (VMS) is an immersive VR system where the user can interact with an archive of digitized artworks placed in a virtual space representing a stylized square, recalling the real Cathedral Square of Pietrasanta (the "city of marble and artists"). Differently from the MPF, which was mainly a demonstrator of VR potentials applied to a heterogeneous collection of artworks, the VMS keeps a strong coherence, being all the exhibited virtual sculptures related to significant artists of the xx century operating in Pietrasanta.

The visualization system consists of a panoramic stereo screen 7.5 meters wide (Fig. 5), curved in a cylindrical shape in order to provide a high-immersion field of view. The interaction is achieved by means of a handheld trackball, which allows to select the desired sculpture and to view it from any possible perspective and distance. A series of overlaid texts and images, along with a vocal narration, provide information about artworks, styles and authors.

A user evaluation was performed during an exhibition where 50 people were asked to fill in a questionnaire answering questions on a 5-point Likert scale. The overall acceptance was very high, with a global good acceptance (rates 4 and 5) of 74% and high ratings for interaction (82%) and immersion (64%) features, acknowledging in the latter case a slightly better impact to the panoramic screen than to stereoscopy. Lesser enthusiasm was shown for the presented content (28%, however only 2% was neg-

Fig. 5. Virtual Museum of Sculpture.

ative – rates 1 and 2) and for the degree of learning (34% vs 8%). This can probably be explained by the fact that, being the exhibition very crowded, users had a short time trial (usually not more than 5 minutes) mostly concentrated on experiencing and enjoying the system. Although the setup is simpler than the Pure Form one, in terms of devices, and can be controlled even by non-trained operators, the panoramic powerwall is quite sizeable and needs large dedicated spaces. Following this need, local institutions have funded the construction of larger and independent premises for the VMS, which will be also enriched by additional content and components.

4.2.3. The Virtual Exploration of Turandot stage

On the occasion of an exhibition dedicated to Giacomo Puccini and his works, we presented a VR installation enabling users to be immersed in a VE based on the reconstruction of the stages of the Turandot opera, as they appeared in the original sketches made by the painter Galileo Chini.

The time flow of the virtual travel corresponds to that of the real opera, so as to realize a guided tour inside the opera itself through the navigation in its stages and its music. The panoramic visualization system (Fig. 6) is similar to that of VMS and allows to have a wide field of view which facilitates the immersion of visitors. The installation is completed by two further projection surfaces consisting in semi-transparent panels hung to the ceiling at an opportune distance from the screen. The panels show movies of actors executing some of the most famous Turandot arias, enhancing the overall three-dimensional effect thanks to these two levels of real parallax in addition to virtual ones. Using transparent materials allows to save the visibility of the rest of the system, producing an effect similar to floating holograms which make the overall experience even more suggestive.

No actual evaluation was performed, although a number of opinions were informally collected during the demonstration and the success of the exhibition has witnessed a good acceptance of this kind of installation. The lack of interaction was not considered a big issue, as it was counterbalanced (being the installation multi-user) by the possibility of gathering in small groups and discussing about the opera and this virtual representation. From a technical point of view, the installation did not need specific skills to be controlled, therefore a very quick training of the operators was sufficient. Nonetheless, in the very first days of the exhibition, an unforeseen overheating problem needed an intervention of our team to be fixed. After this, a detailed recovery procedure was given to the operators that were afterward able to solve themselves a couple of further occurrences of the same issue.

4.2.4. Virtual Livorno

This project produced a non-interactive stereoscopic installation, exposed in a dedicated museum exhibition and showing a high quality animated rendering of the urban evolution of Livorno downtown starting from 1606 till 1732. The resulting environment remained untouched up to the heavy devastations occurred in the course of World War II, when almost the whole center of the town was completely destroyed from bombing.

The exhibition, held at Museo Fattori, was to last 1 month but, due to the good success in terms of audience and requests of cultural and educational institutions, it was extended to last 6 months. Differently from the above-mentioned installations, this system has been meant for a large audience (as shown in Fig. 7) with a more cinematographic approach. The only possible interaction was the selection of a particular chapter of the story by means of a touchscreen interface. Yet, despite of the lack of interaction, people felt enough immersed in the narration to enjoy a 30-minute experience, quite longer than the previously presented ones.

This is the simplest of the presented systems and, consequently, the less prone to problems and technical issues. From the user point of view, the only remarkable annoyance was the need to wear stereoscopic glasses. Quite surprisingly, and in spite of the com-

Fig. 6. Turandot panoramic installation.

Fig. 7. The audience of the Virtual Livorno installation.

positeness of the audience including large amount of people who could be hardly defined as technology enthusiasts, no one complained about this, probably because the system was placed at the end of the exhibition course and, therefore, glasses had to be put on and removed just once.

5. Lessons learned

As aforementioned, systems placed in the top-right corner of the proposed classification are likely to provide a pleasant and significant virtual experience. This is especially true when dealing with cultural heritage applications of VR. In fact, one of the features that distinguishes these applications is that they are commonly operated by the general public. This means that typical users are non-experienced and non-trained people, usually at their first attempt of controlling installations of such a complexity. Other popular application sectors of VR, such as industry or medicine, require users to spend a lot of time to practice systems, as their goal is commonly related to training or simulation. Cultural heritage systems, unless they are not devoted to professional users, are instead usually meant to provide a meaningful and pleasant experience in a very limited amount of time, which prevents them to have slow learning curves. Ideally, a user of such systems should be able to identify, at a glance, the context and the interaction modes without having to think too much. This represents a valid reason to like natural interaction better than device-mediated interaction. However, this choice is commonly not sufficient, as adequate interaction metaphors have to be designed in order to effectively exploit the potential of this kind of interfaces. On the other side, immersive systems, although providing a better overall experience as they induce a deeper participation and involvement of users increasing their ability to absorb concepts and information [18], are usually more expensive, more complex to setup, maintain and master, and require large dedicated spaces. Hence, the optimal solution should rise from an accurate analysis of the target in terms of aims, user profiles, spaces and resources.

6. Conclusions

As for our experience, immersive VR has all the potentials to become a very effective means to communicate cultural content. The presented examples have shown that this technology, thanks to its compelling and appealing features, might act as a "picklock" particularly useful to target segments of the public, especially young people, more comfortable with new media than with traditional communication means.

Yet, as a matter of fact, the use of this technology is not as widespread as one could expect, for a series of reasons which we here try to summarize:

"Hmm, this VR thing is expensive..."
The devices used in immersive VR systems have still non-negligible costs, although the situation in latest years has dramatically improved thanks to the massive introduction of consumer technology. However, the cost of immersive systems is still so high as to prevent a wide spread in cultural institutions, limiting their employment only to the most important structures. For the same reason, also maintenance costs are commonly high, especially if considering that interaction devices are usually in direct contact with users and likely to suffer wear and tear, which might considerably weigh upon overall costs.

"Can't you do it alone?"
A similar consideration might be done for the development of VR applications content. A VR system is in fact based on data and elements that, typically, are realized ex-novo every time: 3D models, multimedia, speeches, images, texts, etc. This usually implies the presence of a team with multidisciplinary expertise, ranging from Art History to Storytelling, 3D graphics, Programming and so on. Moreover, the absence of standard development tools makes often necessary to develop custom components, which can considerably extend times and costs of implementation.

"Do I have enough room for this?"
Compared with simple multimedia kiosks, immersive VR systems usually need rather large spaces, even if they are limited only to visual feedback. When dealing with more complex systems involving also other types of feedback, like force-feedback, the amount of devices and the global encumbrance may become onerous. In this case, dedicated spaces (and specific trained personnel) are often needed, which evidently limits an effective integration in the museum spaces.

"I don't want to wear that stuff!"
Although the most recent lines of research are focusing on the development of devices as transparent to users as possible, so far using a VR system implies the adoption of tools that often need to be somehow worn by users: stereo glasses, headphones, sensors and even robotic interfaces. This need conflicts with the opportunity of providing seamless courses and points out user acceptance problems: not everyone is willing to wear devices, especially when dealing with mechanical appliances which might look "scary" and intimidating. Even simple devices, like stereo glasses, might strain users if they have to intermittently put on and remove them, whilst portable devices (like for instance audio-guides, I-Pods, smart guides etc.) are usually better accepted as they do not cause a shift of the perception, but rather they augment it.

"Feel so lonely..."
Immersive VR is mostly a single-user experience. Beyond the concerns already made about spaces, which inevitably increase when dealing with large groups of people, as a matter of fact some of the fundamental issues of an immersive system, such as the dynamic visual perspective computed based on the user's head position, implicitly assume a system used by a single person. This imposes a severe limitation in environments classically devoted to large audiences, as museums and exhibition spaces. Of course multi-user systems exist, some of them described in previous sections, but they usually lack of interaction. So far, this is an unavoidable trade-off, although current research is trying to keep into account these considerations so as to promote alternate solutions.

"The Gugghenheim effect"
Nowadays, the worlds of technology and classical culture are cooperating more and more closely. Yet different languages, misunderstandings and mutual mistrusts, lead only to moderate advances in this process. The insertion of technology in museum environments is sometime considered as a factor able to threaten, or even to undermine, with playful elements the authoritativeness of the institution. Although this mind is slowly changing, still some pockets of resistance survive nourished by non-trivial concerns, which cannot be disregarded. One of the most dreaded risks is what we call the "Guggenheim effect", i.e. the appeal of the container pushing into the background the essential element, the content, resulting a distracter rather than an opportunity to convey information.

Is therefore worthwhile a joint effort by all actors in order to make these technologies more and more usable and useful. From a technology perspective, current efforts are aimed at producing and using devices less expensive, less complex, more easily and cheaply sustainable, and as transparent as possible to the users. Research trends are complying with these directions: gesture recognition systems avoid the need of wearing sensors, gloves or suits, allowing at the same time for a natural and effective interaction. Autostereoscopic displays, which have constantly increasing dimensions and performances, allow to perceive three-dimensional images without having to wear glasses or helmets.

On the other side, the increasing penetration of certain types of equipment in everyday life fosters a better and more likely acceptance of complex technology. The spreading of mobile systems, palmtops and cellular phones, makes almost immediate their usage for information or description purposes (for instance as audio, video or augmented reality smart guides), as well as the growing familiarity of the general public with sophisticated interaction devices, like touch-screens, camera-based appliances or motion sensors (just think at the huge success of devices like the iPhone or the Nintendo Wii), will result in a more and more natural employment of similar technologies. Furthermore, this will also result in a substantial decrease of the initial approach start-up time, which often still constitutes a significant part of the time spent in an installation. The fast evolution of consumer technologies in this field, moreover, allows more and more frequently to adopt commercial devices, with accessible costs, instead of expensive ad-hoc appliances as it used to happen until not too many years ago.

Finally, we believe that the residual communication problems between the humanistic and the technological worlds will become just as less important as the collaboration between them will be more integrated. Today, the development process still entails that the "knowledge exchange" takes place only at the very beginning, where user needs are collected, and in the final phase, where the experience is evaluated. Sometimes, these phases are extremely reduced in time, and occasionally do not even exist. The introduction of an accurate design stage, with participants of both worlds, centered on users and their needs, and followed by a development stage where this integrated cooperation extends throughout the whole course, will hopefully lead to realize better products. At the same time is also important to activate a methodological course based on a set of guidelines aimed to minimize problems due to miscommunication. Such a structured methodology will also result in a more accurate and careful selection of content, which would benefit of a spectacular container, at the same time remaining in the foreground as the central element of these cultural experiences.

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